SHF Systems

SHF-LO

Building-Block Local Oscillator

Assembly and Operational Guide

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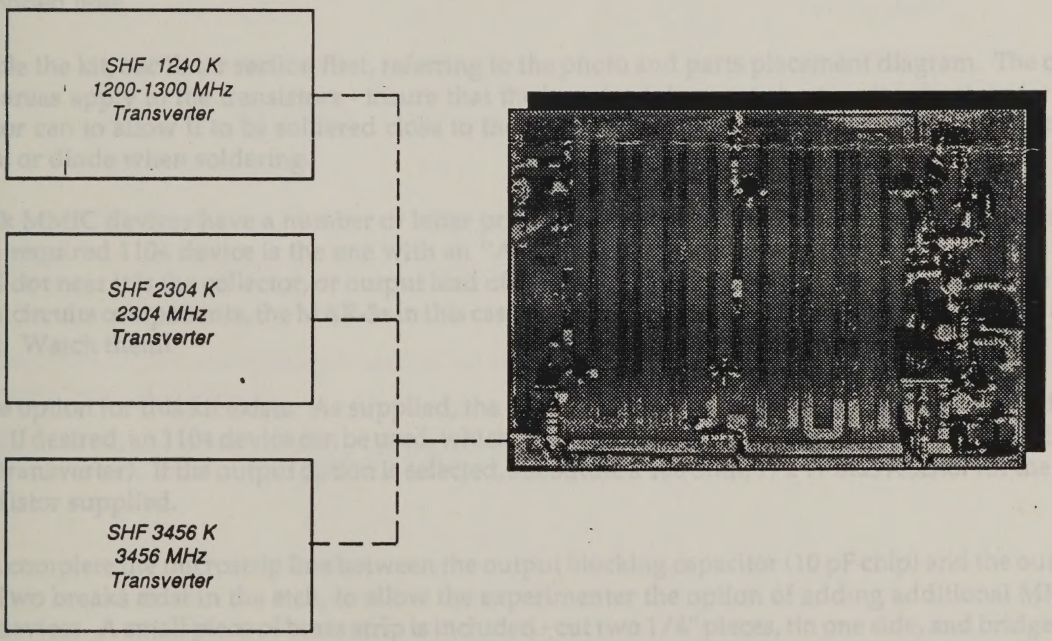
Introduction

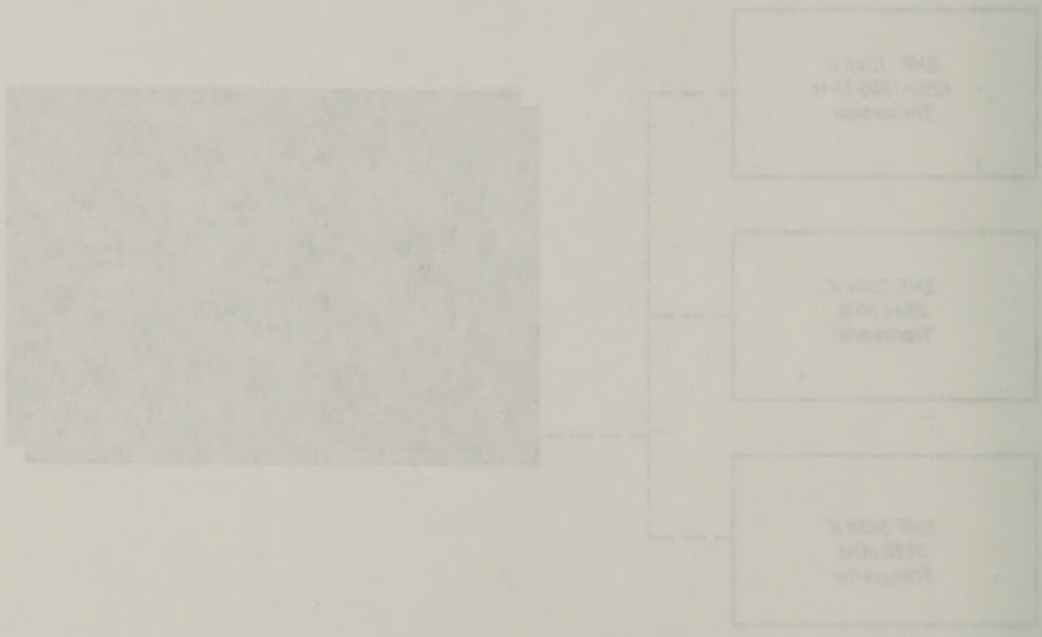
The SHF Systems Local Oscillator is a clean, physically compact module intended for use in microwave transverters and converters. It employs pretuned, etched microstrip filters that require no user adjustment. The high rf output of UP TO +14 dBm into 50 ohms is ideal for today's amateur applications.

The SHF LO is especially applicable to 1269 - 1296 MHz, 2304 - 2400 MHz, and 3456 MHz transverters using an i-f frequency of 144 MHz. The LO produces output in the range 540-580 MHz, which is appropriately multiplied in the transverter for LO injection.

The SHF LO kit can be assembled in under two hours. The only "special" tool required is a tweezers or very small needle nose for handling chip capacitors. No adjustment other than the crystal oscillator frequency trim is required. The kit should work perfectly, or not at all!

This product was originally designed by Richard Campbell, KK7B. Constructive modifications are credited to Al Ward, WB5LUA and Jim Davey, WA8NLC. Quality components are provided for the kit builder, and any defective component will be unconditionally replaced within 90 days of purchase.





ASSEMBLY INSTRUCTIONS

The only tools required for assembly are standard electronic hand tools, a low power soldering station, and possibly tweezers for handling the chip capacitors. Two standard drill bits are required to form the inductors.

The well worn cliche referring to pictures and words applies here. The photo, coupled with the parts placement diagram, provides almost all that is needed to assemble this kit. The actual shape of several components, most notably the trimmer cap and transistors, might vary from the photo, but their placement remains the same.

The oscillator section, on the left side of the board, is built "dead bug" style, that is, components are soldered to the pc board and interconnected using their own leads. There are no sockets, as none are required. The absolute parts placement is not critical.

It is necessary to ground one pad in the oscillator section to the ground-plane. Position the board as indicated in the photo, and find the ground pad directly above the diode. Using the clipped lead from a resistor, form a "Z" wire and solder the wire to the component side pad and the groundplane, using the provided hole.

Assemble the kit, oscillator section first, referring to the photo and parts placement diagram. The only critical areas apply to the transistors - insure that the base lead does not short, as it is bent under the transistor can to allow it to be soldered close to the board. Of course, don't overheat the transistors, MMICs, or diode when soldering.

Avantek MMIC devices have a number or letter printed on the case. If you are building a high output LO, the required 1104 device is the one with an "A" on the case. With these devices, the lead with a molded dot near it is the collector, or output lead of the device. This is obvious in the photo. However, the Minicircuits components, the MAR-3s in this case, have the case dot on the INPUT lead, which is also slashed. Watch them!

A single option for this kit exists. As supplied, the output MMIC is a 0404 which produces +9-10 dBm output. If desired, an 1104 device can be used, which will produce +14 dBm output (required for the SHF 3456 A transverter). If the output option is selected, substitute a 100 ohm, 1/2 W bias resistor for the 150 ohm resistor supplied.

Finally, complete the microstrip line between the output blocking capacitor (10 pF chip) and the output filter. Two breaks exist in the etch, to allow the experimenter the option of adding additional MMIC power devices. A small piece of brass strip is included - cut two 1/4" pieces, tin one side, and bridge the two gaps as indicated in the photo.

Apply 13.2 - 13.8 V. Power may be brought to the LO at several places. I suggest one of the pads on the center edge of the board, on the cold side of 220 ohm or 470 ohm bias resistors. The board should draw about 170 - 180 mA if all is well.

For the experimenter, the only possible tweak to gain a slight amount of output involves slightly adjusting the turn spacing of the inductors forming the matching network for the diode. Some type of power output indicator is needed to do this, and it is not necessary if the inductors were formed as indicated.

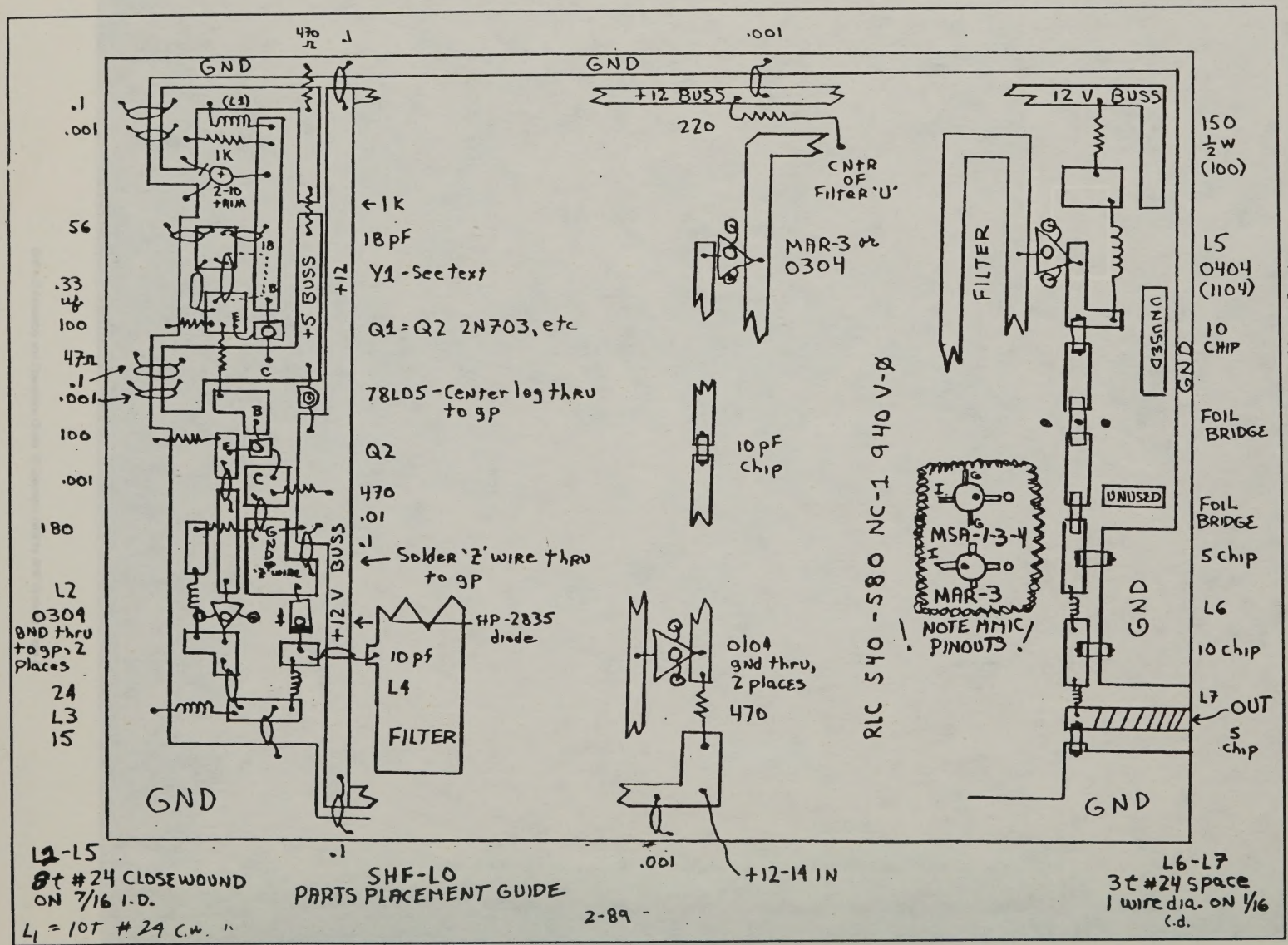
USAGE

The SHF LO is intended to be used as part of an associated line of transverters. These transverters employ an appropriate LO multiplier circuit that produces the actual injection frequency. However, the SHF LO may be used with any mixer configuration. The following table provides crystal information and multiplication factors for several amateur bands, using 144 MHz i-f and low side injection.

BAND	SHF LO XTL FREQUENCY	EXTERNAL MULTIPLICATION	INJECTION FREQUENCY
1269	93.75 MHz (Mode L)	x 2	1125.0 MHz
1296	96.00 MHz (Weak Signal)	x 2	1152.0 MHz
2304	90.00 MHz (Weak Signal)	x 4	2160.0 MHz
2400	94.00 MHz (Mode S)	x 4	2256.0 MHz
3456	92.00 MHz (Weak Signal)	x 6	3312.0 MHz

In all cases the LO crystal frequency is multiplied six times on the SHF LO board, resulting in an output in the range 540 - 580 MHz.

If you have any questions concerning the use of the SHF LO, please call or write.



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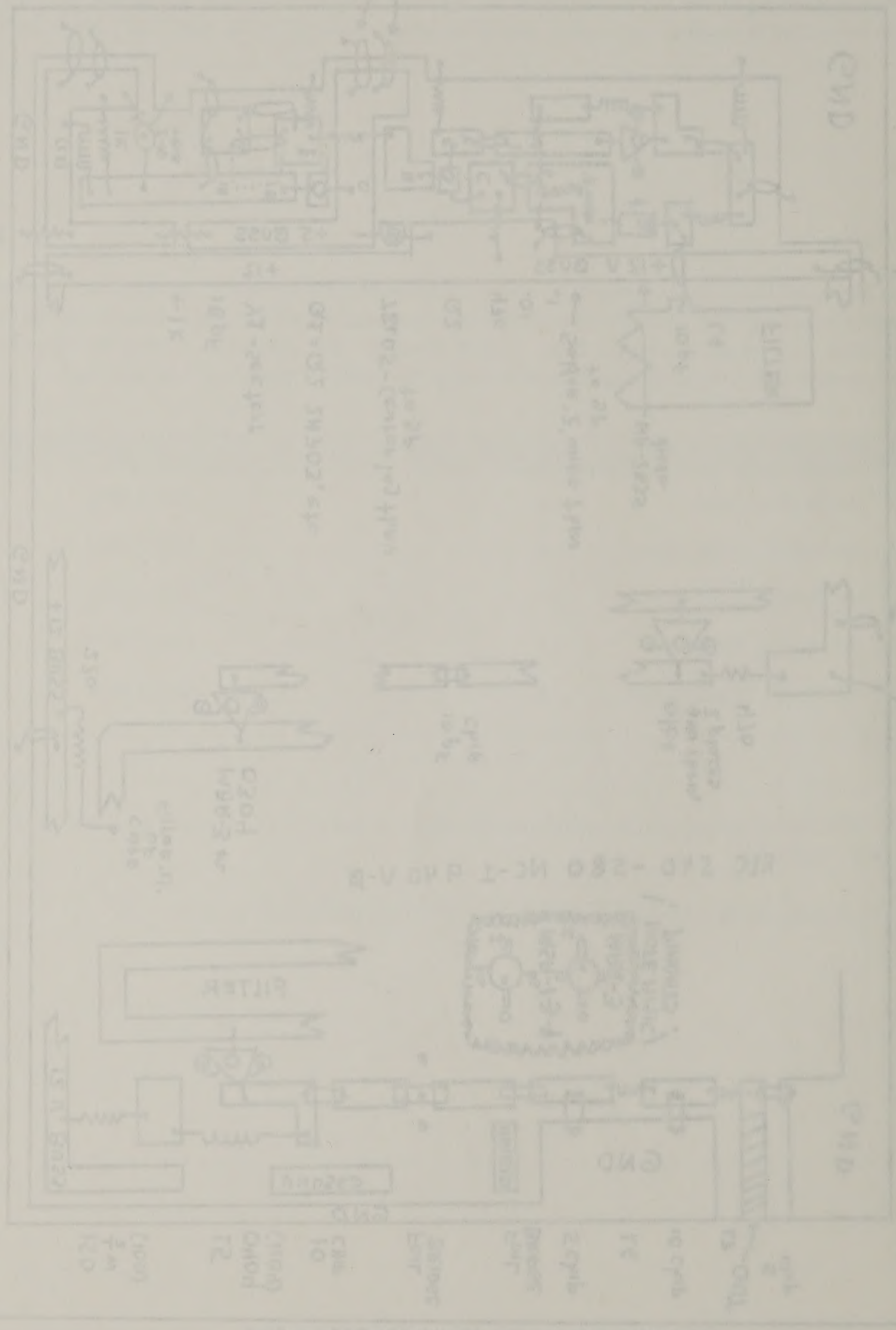
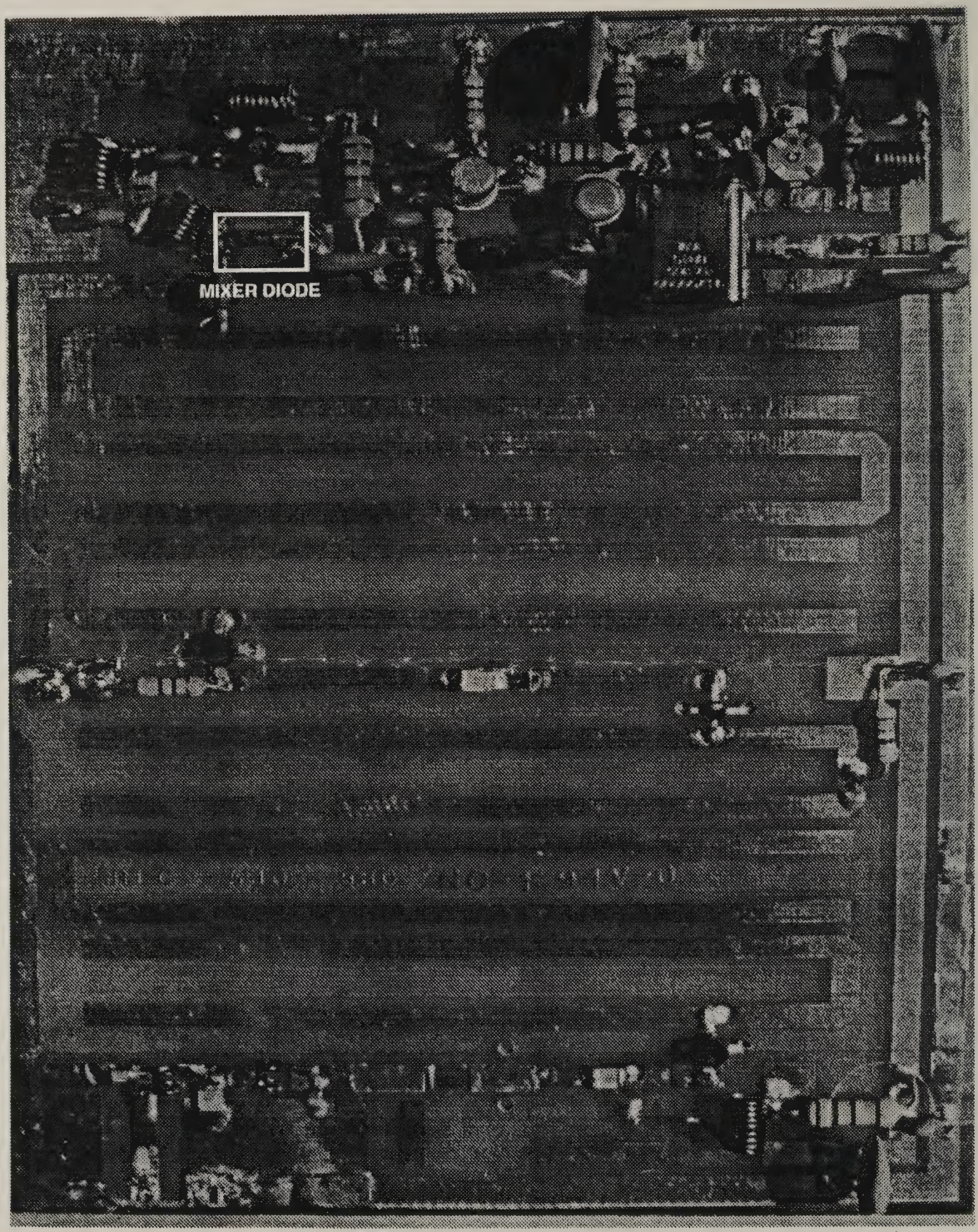



MIXER DIODE

SHF-LO Parts List

Capacitors

6 - .1 disc ceramic (104)
1 - .01" " (103)
6 - .001 " " (102)
1 - 10 pF " "
1 - 15 pF " "
1 - 18 pF " "
1 - 24 pF " "
1 - 56 pF " "
3 - 10 pF chip
2 - 5 pF chip
1 - 2-10 pF trimmer

Resistors - all 1/4 ohm unless indicated

1 - 47 ohm
2 - 100 ohm
1 - 150 ohm 1/2 W (use 100 ohm if 1104 output stage selected)
1 - 180 ohm 1/2 W
1 - 220 ohm
3 - 470 ohm
2 - 1k ohm

Chokes and Inductors

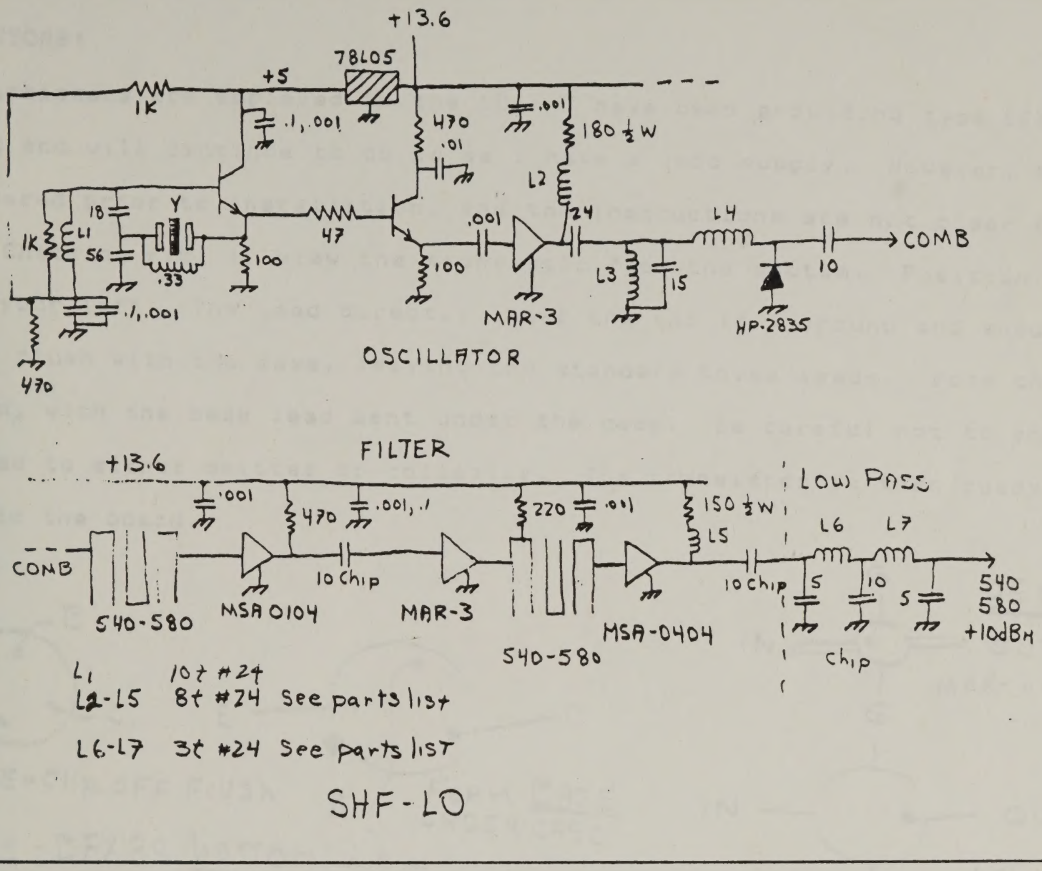
1 - .33-.39 uH epoxy rfc
5 - 8 t, #24 closewound on .1" i.d. (use 7/64" or #33 drill as form) (L1 = 10 turns)
2 - 3 t, #24 spaced one wire diameter on 1/16" drill as form

Active

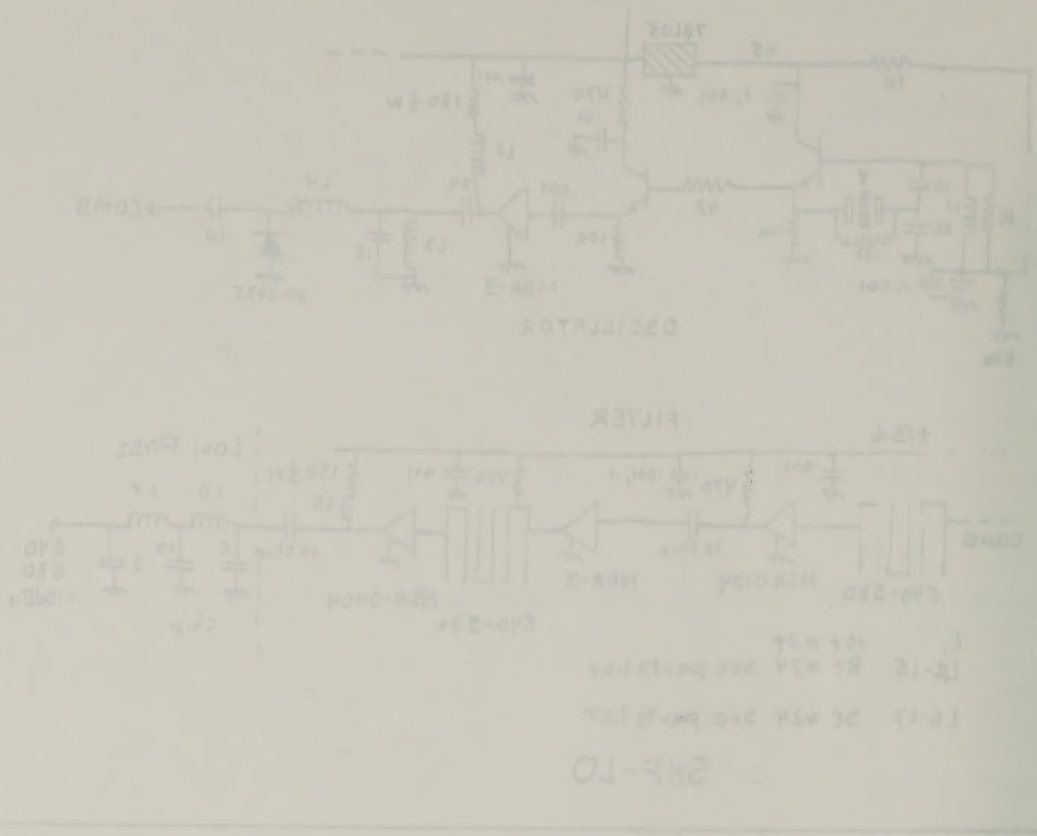
2 - MSA 0304 MMIC (or MAR-3 orange dot MMIC)
1 - MSA 0104 or MAR-1
1 - MSA 0404 (or 1104 for high power option, used with 100 ohm bias resistor)
2 - vhf NPN silicon transistors, 2N703, 2N5179, 2N5770, etc. may vary
1 - 78L05 plastic +5 Vreg

Misc

1 - HP-2835 or equiv. diode
1 - XTL, HC/18, 5th overtone, see text for frequency selection
1 - plated and drilled PC board
1 - .5" piece brass foil
1 - instruction manual



SHF-LO Schematic Diagram



TRANSISTORS:

Two transistors are employed in the LO. I have been providing type BFX-89 ... the kit and will continue to do so as I have a good supply. However, they ... be prepared prior to installation, and the instructions are not clear in th... area. Checking Fig. 1, view the transistor from the bottom. Position the tab to your left. The lead directly under the tab is a ground and should be cut off flush with the case, leaving the standard three leads. Form the lea... as shown, with the base lead bent under the case. Be careful not to short t... base lead to either emitter or collector. The transistor is then ready to solder to the board.

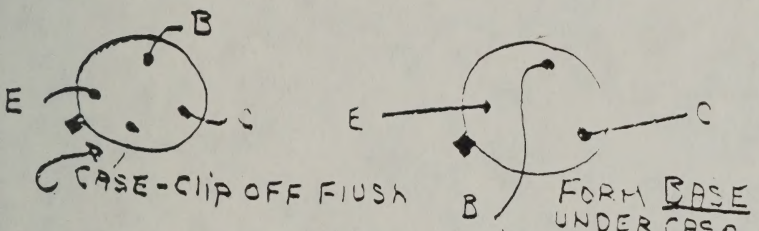
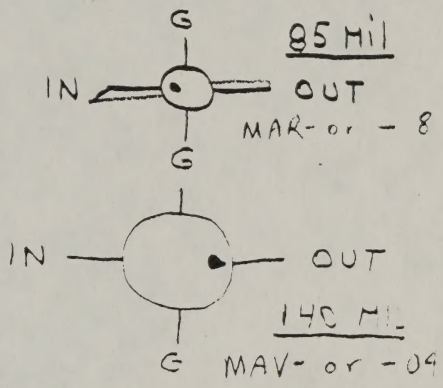


Fig 1 - BFX 89 bottom view

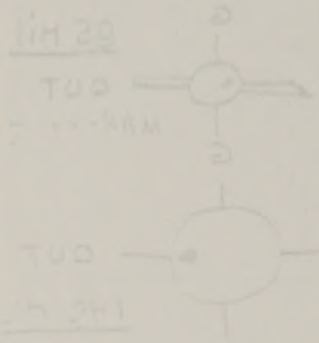


MMIC's ↑

Avantek is 0185 0685 etc for small pkg or 0104 0404 etc for large pkg

Min Circuits equivalents are MAR- and MAV

MAR-1 = MSA 0185, MAV-11 = MSA-11 etc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